

WHAT IS CLAIMED IS:

- 1        1. A scheduling system comprising:
  - 2            a time slot for specifying the transfer sequence of
  - 3            individual lines in one turn, in which each cell is transferred,
  - 4            in slots indicating respective points in the turn;
  - 5            a cell read sequence management table which has elements
  - 6            in the same number as the number of slots provided in the time
  - 7            slot and sets the lines as cell transfer objects to the
  - 8            elements;
  - 9            schedule computation means for controlling the setting of
  - 10          the lines to the cell read sequence management table;
  - 11          allocation processing means for converting the elements
  - 12          of the cell read sequence management table respectively to
  - 13          specified positions of the slots in the time slot; and
  - 14          a schedule management table for indicating positions,
  - 15          within the cell read sequence management table, to which
  - 16          transfer object lines are newly set, for each PCR value of the
  - 17          lines, said PCR value being the number of cells, transferred
  - 18          from the line, per cell transfer turn and representing the cell
  - 19          send rate of each line,
  - 20          the specified line cells being successively transferred
  - 21          for each turn according to the sequence specified in the time
  - 22          slot,
  - 23          the cell read transfer sequence in each line being
  - 24          controlled according to the cell send rate in each of the lines.
- 1        2. The scheduling system according to claim 1, wherein

2       the schedule computation means comprises:

3           means which, when a requirement is satisfied such that  
4       there is an idle element, in the cell read sequence management  
5       table, which is located one element ahead of a position of an  
6       element corresponding to a value obtained by multiplying the  
7       specified PCR value by an integer, and the contemplated line  
8       can be set to continuous elements starting from the idle  
9       element and corresponding to the specified PCR value and, in  
10      addition, when an element is present in the heading area of the  
11      continuous elements, functions to catalog the position of said  
12      element, which is located one element ahead of a position of an  
13      element corresponding to a value obtained by multiplying the  
14      specified PCR value by an integer, as data indicating the set  
15      position of the line having the specified PCR value, in  
16      relation with the PCR value in the schedule management table;

17       means which, when a line to be newly transferred has  
18      occurred, newly sets the line to continuous elements  
19      corresponding to the PCR value of the line, in the cell read  
20      sequence management table, from the set position corresponding  
21      to the PCR value of the line recorded in the schedule  
22      management table;

23       means which, when the communication of a line being  
24      currently transferred has been deleted, cancels the setting of  
25      the line from the element, in the cell read sequence management  
26      table, to which the line has been set; and

27       means which, when new setting or delete of a transfer  
28      object line has occurred, updates the catalog of the schedule  
29      management table.

1           3. The scheduling system according to claim 2, wherein  
2           the allocation processing means comprises:

3           means which converts the elements within the cell read  
4           sequence management table, to respective specified positions  
5           within the time slot, based on the designation of the slot  
6           position as the conversion destination for each element  
7           specified in such a manner that the continuous elements  
8           corresponding to the PCR value, that have been ensured from a  
9           position which is one element ahead of a position of an element  
10          corresponding to a value obtained by multiplying the PCR value  
11          by an integer, in the cell read sequence management table are  
12          converted to respective positions dispersed at equal spacings  
13          in the time slot; and

14          means which, when a line is in the state of being set to  
15          elements in the cell read sequence management table, performs  
16          specifying and setting, in a slot as the conversion destination  
17          of the line in the time slot, so as to transfer cells of the  
18          line.

1           4. The scheduling system according to claim 2 or 3,  
2           wherein the number of slots in the time slot and the PCR value  
3           of each of the lines each are a value obtained by raising "2"  
4           to the nth power, wherein n is a non-negative integer.

1           5. The scheduling system according to claim 4, wherein  
2           the conversion from the cell read sequence management  
3           table to the time slot is carried out by a method comprising

4 the steps of:

5 raising "2" to the "A<sup>th</sup>" power, wherein "A" is an  
6 integer, to provide a value as the length of the time slot;

7 indicating the positions of the individual elements in  
8 the cell read sequence management table and the slot positions  
9 of the time slot by using continuous numbers from "1" to the  
10 value of the time slot length;

11 taking each element from the cell read sequence  
12 management table;

13 subtracting "1" from the value of the continuous numbers  
14 in the element and expressing the obtained value in terms of  
15 binary number of "A" digits while, when a high order value is  
16 absent, supplementing "0";

17 converting the numerical values of the "A" digits  
18 expressed in terms of binary number so as to be reversed in  
19 sequence with respect to the arrangement from higher order  
20 digit to lower order digit to provide a converted binary number  
21 of "A" digits; and

22 adding "1" to the value of the converted binary number of  
23 "A" digits to determine a value as a slot position, in the time  
24 slot, which is the element conversion destination.

1 6. The scheduling system according to any one of claims 2  
2 to 5, wherein the schedule computation means performs a  
3 function such that, upon the cancellation of the setting of a  
4 line from the elements in the cell read sequence management  
5 table, if another line having a smaller PCR value than said  
6 line is in the state of being set to a position behind the

7 position to which the said line has been set, the set position  
8 of said another line is moved to the position from which the  
9 setting of said line has been cancelled.

1       7. The scheduling system according to any one of claims 2  
2 to 5, wherein the schedule computation means performs a  
3 function such that, upon the cancellation of the setting of a  
4 line from the elements in the cell read sequence management  
5 table, if other lines having a smaller PCR value than said line  
6 are in the state of being set to positions behind the position  
7 to which the said line has been set, the set position of one  
8 line, which has the largest PCR value in said other lines and  
9 is located in the rearmost position of said other lines, is  
10 moved to the position from which the setting of said line has  
11 been cancelled.

1       8. The scheduling system according to any one of claims 1  
2 to 7, wherein said line is an ATM line.

1       9. A scheduling method comprising the steps of:  
2           indicating the send rate of cells in each line in terms  
3 of PCR value which is the number of cells, transferred from the  
4 line, per cell transfer turn;  
5           successively transferring cells of a specified line  
6 according to the sequence specified in slots, in a time slot  
7 for specifying the transfer sequence of individual lines in the  
8 cell transfer turn, indicating each point in the turn;  
9           controlling the setting of each line in a cell read

10 sequence management table which has elements in the same number  
11 as the number of slots provided in the time slot and sets the  
12 lines as cell transfer objects to the elements;

13 converting the individual elements in the cell read  
14 sequence management table to respective specified slot  
15 positions in the time slot; and

16 properly updating and making reference to a schedule  
17 management table which indicates positions, within the cell  
18 read sequence management table, to which transfer object lines  
19 are newly set, for each PCR value of the lines,

20 the cell read transfer sequence in each line being  
21 controlled according to the cell send rate in each of the lines.

1 10. The scheduling method according to claim 9, which  
2 further comprises the steps of:

3 when a requirement is satisfied such that there is an  
4 element, in the cell read sequence management table, which is  
5 located one element ahead of a position of an element  
6 corresponding to a value obtained by multiplying the specified  
7 PCR value by an integer, and the contemplated line can be set  
8 to continuous elements starting from the idle element and  
9 corresponding to the specified PCR value and, in addition, when  
10 an element is present in the heading area of the continuous  
11 elements, cataloging the position of said element, which is  
12 located one element ahead of a position of an element  
13 corresponding to a value obtained by multiplying the specified  
14 PCR value by an integer, as data indicating the set position of  
15 the line having the specified PCR value within the cell read

16 sequence management table, in relation with the PCR value in  
17 the schedule management table;

18 when a line to be newly transferred has occurred, newly  
19 setting the line to continuous elements corresponding to the  
20 PCR value of the line, in the cell read sequence management  
21 table, from the set position corresponding to the PCR value of  
22 the line recorded in the schedule management table;

23 when the communication of a line being currently  
24 transferred has been deleted, canceling the setting of the line  
25 from the element, in the cell read sequence management table,  
26 to which the line has been set; and

27 when new setting or delete of a transfer object line has  
28 occurred, updating the catalog of the schedule management table.

1 11. The scheduling method according to claim 10, which  
2 further comprises the steps of:

3 converting the elements within the cell read sequence  
4 management table, to respective specified positions within the  
5 time slot, based on the designation of the slot position as the  
6 conversion destination for each element specified in such a  
7 manner that the continuous elements corresponding to the PCR  
8 value, that have been ensured from a position which is one  
9 element ahead of a position of an element corresponding to a  
10 value obtained by multiplying the PCR value by an integer, in  
11 the cell read sequence management table are converted to  
12 respective positions dispersed at equal spacings in the time  
13 slot; and

14 when a line is in the state of being set to elements in

15 the cell read sequence management table, performing specifying  
16 and setting, in a slot as the conversion destination of the  
17 line in the time slot, so as to transfer cells of the line.

1           12. The scheduling method according to claim 10 or 11,  
2 wherein the number of slots in the time slot and the PCR value  
3 of each of the lines each are a value obtained by raising "2"  
4 to the nth power, wherein n is a non-negative integer.

1           13. The scheduling method according to claim 12, wherein  
2 the conversion from the cell read sequence management  
3 table to the time slot is carried out by a method comprising  
4 the steps of:

5           raising "2" to the "A<sup>th</sup>" power, wherein "A" is an  
6 integer, to provide a value as the length of the time slot;  
7           indicating the positions of the individual elements in  
8 the cell read sequence management table and the slot positions  
9 of the time slot by using continuous numbers from "1" to the  
10 value of the time slot length;

11          taking each element from the cell read sequence  
12 management table;

13          subtracting "1" from the value of the continuous numbers  
14 in the element and expressing the obtained value in terms of  
15 binary number of "A" digits while, when a high order value is  
16 absent, supplementing "0";

17          converting the numerical values of the "A" digits  
18 expressed in terms of binary number so as to be reversed in  
19 sequence with respect to the arrangement from higher order

20 digit to lower order digit to provide a converted binary number  
21 of "A" digits; and

22 adding "1" to the value of the converted binary number of  
23 "A" digits to determine a value as a slot position, in the time  
24 slot, which is the element conversion destination.

1       14. The scheduling method according to any one of claims  
2 10 to 13, wherein, upon the cancellation of the setting of a  
3 line from the elements in the cell read sequence management  
4 table, if another line having a smaller PCR value than said  
5 line is in the state of being set to a position behind the  
6 position to which the said line has been set, the set position  
7 of said another line is moved to the position from which the  
8 setting of said line has been cancelled.

1       15. The scheduling method according to any one of claims  
2 10 to 13, wherein, upon the cancellation of the setting of a  
3 line from the elements in the cell read sequence management  
4 table, if other lines having a smaller PCR value than said line  
5 are in the state of being set to positions behind the position  
6 to which the said line has been set, the set position of one  
7 line, which has the largest PCR value in said other lines and  
8 is located in the rearmost position of said other lines, is  
9 moved to the position from which the setting of said line has  
10 been cancelled.

1       16. The scheduling method according to any one of claims  
2 9 to 15, wherein said line is an AMT line.

1       17. An ATM switch comprising a scheduling system such  
2       that the cell read transfer sequence in each ATM line is  
3       controlled according to the cell send rate in each of the ATM  
4       lines, wherein

5               said scheduling system

6               expresses the cell send rate, in each of the ATM lines,  
7       in terms of PCR value, which is the number of cells,  
8       transferred from the ATM line, per cell transfer turn and  
9       comprises:

10              a time slot for specifying the transfer sequence of the  
11       ATM lines in one turn, in which each cell is transferred, in  
12       slots indicating respective points in the turn;

13              a cell read sequence management table which has elements  
14       in the same number as the number of slots provided in the time  
15       slot and sets the ATM lines as cell transfer objects to the  
16       elements;

17              schedule computation means for controlling the setting of  
18       the ATM lines to the cell read sequence management table;

19              allocation processing means for converting the elements  
20       of the cell read sequence management table respectively to  
21       specified positions of the slots in the time slot; and

22              a schedule management table for indicating positions,  
23       within the cell read sequence management table, to which  
24       transfer object ATM lines are newly set, for each PCR value of  
25       the ATM lines,

26              the specified ATM line cells being successively  
27       transferred for each turn according to the sequence specified

28 in the time slot.

1        18. The ATM switch according to claim 17, wherein  
2                  the schedule computation means comprises:

3                  means which, when a requirement is satisfied such that  
4                  there is an idle element, in the cell read sequence management  
5                  table, which is located one element ahead of a position of an  
6                  element corresponding to a value obtained by multiplying the  
7                  specified PCR value by an integer, and the contemplated ATM  
8                  line can be set to continuous elements starting from the idle  
9                  element and corresponding to the specified PCR value and, in  
10                 addition, when an element is present in the heading area of the  
11                 continuous elements, functions to catalog the position of said  
12                 element, which is located one element ahead of a position of an  
13                 element corresponding to a value obtained by multiplying the  
14                 specified PCR value by an integer, as data indicating the set  
15                 position of the ATM line having the specified PCR value, in  
16                 relation with the PCR value in the schedule management table;

17                 means which, when an ATM line to be newly transferred has  
18                 occurred, newly sets the ATM line to continuous elements  
19                 corresponding to the PCR value of the ATM line, in the cell  
20                 read sequence management table, from the set position  
21                 corresponding to the PCR value of the ATM line recorded in the  
22                 schedule management table;

23                 means which, when the communication of an ATM line being  
24                 currently transferred has been deleted, the setting of the ATM  
25                 line is cancelled from the element, in the cell read sequence  
26                 management table, to which the ATM line has been set; and

27 means which, when new setting or delete of a transfer  
28 object ATM line has occurred, updates the catalog of the  
29 schedule management table.

1 19. The ATM switch according to claim 18, wherein  
2 the allocation processing means comprises:

3 means which converts the elements within the cell read  
4 sequence management table, to respective specified positions  
5 within the time slot, based on the designation of the slot  
6 position as the conversion destination for each element  
7 specified in such a manner that the continuous elements  
8 corresponding to the PCR value, that have been ensured from a  
9 position which is one element ahead of a position of an element  
10 corresponding to a value obtained by multiplying the PCR value  
11 by an integer, in the cell read sequence management table are  
12 converted to respective positions dispersed at equal spacings  
13 in the time slot; and

14 means which, when an ATM line is in the state of being  
15 set to elements in the cell read sequence management table,  
16 performs specifying and setting, in a slot as the conversion  
17 destination of the ATM line in the time slot, so as to transfer  
18 cells of the ATM line.

1 20. The ATM switch according to claim 18 or 19, wherein  
2 the number of slots in the time slot and the PCR value of each  
3 of the ATM lines each are a value obtained by raising "2" to  
4 the nth power, wherein n is a non-negative integer.

1        21. The ATM switch according to claim 20, wherein  
2            the conversion from the cell read sequence management  
3            table to the time slot is carried out by a method comprising  
4            the steps of:

5            raising "2" to the "A<sup>th</sup>" power, wherein "A" is an  
6            integer, to provide a value as the length of the time slot;

7            indicating the positions of the individual elements in  
8            the cell read sequence management table and the slot positions  
9            of the time slot by using continuous numbers from "1" to the  
10          value of the time slot length;

11          taking each element from the cell read sequence  
12          management table;

13          subtracting "1" from the value of the continuous numbers  
14          in the element and expressing the obtained value in terms of  
15          binary number of "A" digits while, when a high order value is  
16          absent, supplementing "0";

17          converting the numerical values of the "A" digits  
18          expressed in terms of binary number so as to be reversed in  
19          sequence with respect to the arrangement from higher order  
20          digit to lower order digit to provide a converted binary number  
21          of "A" digits; and

22          adding "1" to the value of the converted binary number of  
23          "A" digits to determine a value as a slot position, in the time  
24          slot, which is the element conversion destination.

1        22. The ATM switch according to any one of claims 18 to  
2            21, wherein the schedule computation means performs a function  
3            such that, upon the cancellation of the setting of an ATM line

4 from the elements in the cell read sequence management table,  
5 if another ATM line having a smaller PCR value than said ATM  
6 line is in the state of being set to a position behind the  
7 position to which the said ATM line has been set, the set  
8 position of said another ATM line is moved to the position from  
9 which the setting of said ATM line has been cancelled.

1           23. The ATM switch according to any one of claims 18 to  
2 wherein the schedule computation means performs a function  
3 such that, upon the cancellation of the setting of an ATM line  
4 from the elements in the cell read sequence management table,  
5 if other ATM lines having a smaller PCR value than said ATM  
6 line are in the state of being set to positions behind the  
7 position to which the said ATM line has been set, the set  
8 position of one ATM line, which has the largest PCR value in  
9 said other ATM lines and is located in the rearmost position of  
10 said other ATM lines, is moved to the position from which the  
11 setting of said ATM line has been cancelled.